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## BIØSTAT, A COMPUTER PROGRAM PROVIDING SIMPLE STATISTICS FOR BIOLOGICAL SAMPLES

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**ABSTRACT:** A computer program developing simple statistics (N, MIN, MAX, RANGE, MEAN, MEDN, SDEV, CVAR, and standard errors of the latter four) is available at the University of Nebraska State Museum, Lincoln.

Data are read into an array of 40 measurements (six columns; maximum 9999.9mm) for a sample maximum of 50 specimens. The "shape" of the array may be adjusted within the maximum "area" of 2000 F-field nodes in each data-set. The data-card input field provides IDENTIFICATION (cc 1-8), CARD (an A, B, C or D in c 9 indicates measurements 1-10, 11-20, 21-30 and 31-40 respectively within the array), SEX (M or F in c 10), SITE (code in cc 11-12 indicates stratigraphic or geographic location), POSITION (L or R in c 13 shows the skeletal geography), AGE-CODE (e.g., "JUV" in cc 15-17 indicates an immature specimen), BONE-CODE (consecutive numbers for all mammalian skeletal elements in cc 18-20), and ten MEASUREMENTS of cc 6 each. Verification subroutines with data-in-error messages are provided.

Output may be on cards, tape or printout. Preliminary statements (sample identification, measurement descriptions), data and statistical results are associated for each data-sequence. The program is open-ended.

In 1969-70, I took measurements on a large number of skull and postcranial elements of Holocene bison in the collections of the University of Nebraska State Museum, which had been obtained from several High Plains sites. These measurements, described and illustrated elsewhere (Hillerud, 1972b), were recorded directly on computer coding-forms and were punched as a series of card data-decks. See Hillerud (1972a, pp 39-40) for a discussion of the repeatability and reproduceability of these measurements. The computer program described below was used to generate simple univariate statistics on these data.

Although every computing center has an equivalent simple-statistics program in its files, most programs are not specifically designed to accommodate biological data. PROGRAM BIØSTAT is presented here because:

(a) its range of measurements, from 0.1 to 9999.9mm, covers a major part of the macrobiological size spectrum,

(b) measurement definitions, other pertinent descriptive information and a list of the raw data are printed in proximity to the statistical printout for each data-set, facilitating its interpretation,

(c) the raw measurements can be recorded directly upon computer coding-forms, and are printed in separated columns, providing easier checking for errors in data-cards,

(d) the verification subroutine provides machine identification of mixed

data-sets, helping to prevent the generation of improper statistics. If cards with errors are encountered, the subroutine stores the contents of the cards for later printout as DATA IN ERROR messages. But it allows the operator to control grouping of selected data-sets, in order to obtain a larger sample, by defining a few control-cards as "comment-cards." The verification of raw data is almost a necessary element in the generation of biostatistics, but it is not commonly provided in standard programs.

(e) the program is economical of CPU time and is open-ended. It can provide output on cards to be used as data-decks for more sophisticated statistical programs.

Initially, the program was called "PROGRAM SIMPSTAT" (Hillerud, 1970b, pp. 50-56, Table 3, 1-12; Hillerud, 1970a, pp. 8-9) but when we recognized that the data-array (the "z-array") generated by the first three subroutines could be used by computational subroutines other than simple univariate statistics, the program was given its present title. A new subroutine, INDEX, which divides each measurement from a single specimen by every other measurement, is being developed.

I am obliged to C. R. Montgomerie, Northern Alberta Institute of Technology, Edmonton, Canada, for initial discussions in 1968 which led to the first draft of "Program Simpstat." J. D. Smith, University of Nebraska Computing Center, debugged and amended the first draft, and wrote the verification subroutine to my specifications and complete satisfaction in 1970. J. M. Inguanzo, of the same department, aided in editing the program for publication in 1972.

I am grateful to the University of Nebraska State Museum, which provided funds for computer consultation and CPU time to develop the program in 1970 as a part of my graduate research, and to The Society of the Sigma Xi, which awarded me a Grant-in-Aid of research of \$200.00 to partially defray publishing costs.

Drs. C. B. Schultz and H. L. Gunderson, University of Nebraska State Museum, and D. F. Costello, University of Nebraska Computing Center, critically read this report. I am indebted to these gentlemen for their interest and editorial criticism, but I accept responsibility for all errors remaining.

#### Characteristics of the Program:

The computer PROGRAM BIÖSTAT utilizes raw data coded in the format described below (see also Figure 1a), placing the numerical data in an array of 2000 F-field nodes, initially 40 measurements by 50 specimens per sample, accepting the data as follows:

- cc 1-8 : specimen identification number,
- c 9 : card-identification code: the letters refer to datum-positions; "A"

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- to measurements 1-10, "B" to 11-20, "C" to 21-30 and "D" to 31-40,
- c 10 : sex: "M" refers to male, "F" to female, "Blank" is not determined,
- cc 11-12: site: a letter-code for geographic or stratigraphic location,
- c 13 : position: skeletal geography; "L" refers to left, "R" to right, "Blank" is not applicable,
- cc 15-17: age: a code for tooth-replacement or tooth-wear; for postcranial elements, "JUV" indicates juvenile specimens, "Blank" is mature,
- cc 18-20: bone-code: refers the numerical data to a specific element, as listed in Table 1. Verification of this column reduces the possibility of mixed-element statistics being generated,
- cc 21-80: (ten) measurements (per card), written in an F6.2 format (xxxx.x).

The program recognizes data-sets by the initial code-word "DATA" in cc 1-4. The end of an individual data-deck is identified by four "Y's" (YYYY) in cc 1-4. The conclusion of the complete data-deck is identified by eight "Y's" (YYYYYYYY) in cc 1-8.

The main program "calls" five subroutines sequentially:

(1) GETPREL accepts and prints explanatory data of any length in an alphanumeric field. These data are immediately available as printout to the researcher. The bone-code (Table 1) should be included in this section.

(2) GETDAT accepts and prints numerical data-sets presented for computation, and assigns the individual measurements to the computation (Z-) array. If an improper datum is encountered, this subroutine stores the contents of the card for later printout as a DATA IN ERROR message at the end of the run.

(3) VERIFY checks card order and homogeneity of the data-set. For example, if a B-card ("B" in c 9) with data for array-spaces 11-20 is encountered without a correct preceding A-card (with data for spaces 1-10), all information on the B-card is stored and later printed as a DATA IN ERROR message. The subroutine also verifies the data-sets by sex, site, position, age and bone-code. Sex, site, position and age-categories are removed from the program as it is reproduced here, allowing mixed data-sets of sufficient size for valid statistical analysis to be run. These control-cards remain in the subroutine deck as comment-cards, and can be re-activated by duplicating them without the "C\*\*\*" in cc 1-4.

(4) PROCES generates statistics upon the z-array data-sets in several sequences. The formulae used in this subroutine are those presented in

Simpson, *et. al.* (1960, chapters 5-6 and pp. 166-167). The statistical parameters N, RMIN, RMAX and RMEDN are developed by computer counting techniques. All formulae are translated into FORTRAN-IV computer language.

(5) PUTDAT prints the statistical computations on the line-printer, and as a punched deck if desired. The printed array includes space for 40 lines of information, of which only the number of measurement parameters are used, and the rest show as "zero". Line 41 records the total number of specimens in the sample. Figure 1(b,c,d) illustrates the printout of an abbreviated data-set.

To avoid possible typographical errors, the working PROGRAM BIØSTAT is presented in facsimile as Table 2.

As here presented, PROGRAM BIØSTAT accepts data in an array of 40 measurements by 50 specimens per data-set sample. A worker wishing to process fewer measurements on a larger sample can change the "shape" of the array by rewriting only a few statements in the program. For example, the following changes will produce a revised program which will accept 20 measurements on 100 specimens. The lines to be changed are marked with marginal dots in the program listing, Table 2.

In JCL machine control, rewrite the job name "BIØSTAT40" as "BIØSTAT20", to define the change.

In the main program, line 4, CØMMØN line 3, change "Z(51,40)" to "Z(101,20)". Duplicate six cards, and insert one for the main program CØMMØN statement, and one for the CØMMØN statements in each of the five subroutines.

In the main program, line 9, change "N40=40" to "N40=20", and line 10, change "N50=50" to "N50=100".

No further changes are necessary. Other adjustments to the "shape" of the array can be easily developed, by changing the nine cards listed above.

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Figure 1

Coding form with data prepared for PRØGRAM BIØSTAT (a). The printout shows measurement definitions (b), listing of measurement data (c) and statistics printout (d) on a data-set of *Bison* radius-ulnae precessed by BIØSTAT.

**a**

MUID	CARD SEX	SITE POSID	AGE	BONE	MEAS (10) →					
					1	2	3	4	5	6
3052-65A	MLL		66	459.0	429.0	344.0	80.0	131.0	97.0	
3053-65A	MLL		66	411.0	393.0	316.0	65.0	100.0	86.0	
3054-65A	MLL		66	416.0	399.0	321.0	66.0	106.0	83.0	
3056-65A	MLL		66			315.0			85.0	
3058-65A	MLL		66	408.0	398.0	320.0	68.0	109.0	89.0	
3060-65A	MLL		66	430.0	419.0	319.0	74.0	132.0	99.0	
					11	12	13			
3052-65B	MLL		66	32.0	90.0	66.0				
3053-65B	MLL		66	21.0	81.0	67.0				
3054-65B	MLL		66	21.0	75.0	57.0				
3056-65B	MLL		66		75.0	55.0				

**b**

	PRELIMINARY STATEMENT - RADIUS-ULNA -BONE CODE NO. 66.
1	TOTAL LENGTH OF ELEMENT.
2	LENGTH OF ULNA.
3	LENGTH OF RADIUS.
4	ANTERIOR-POSTERIOR WIDTH OF OLECRANON.
5	LENGTH OF OLECRANON TO SEMILUNAR NOTCH.
6	LATERAL WIDTH OF PROXIMAL EXTREMITY.
7	WIDTH OF PROXIMAL ARTICULATING SURFACE, RADIUS.
8	ANTERIOR-POSTERIOR WIDTH OF RADIUS, PROXIMAL EXTREMITY.
9	LATERAL WIDTH OF RADIUS SHAFT AT NARROWEST POINT.
10	ANTERIOR-POSTERIOR WIDTH OF RADIUS SHAFT AT SAME POINT.
11	WIDTH (ANT-POST) OF ULNA AT POINT OF SHAFT FUSION.
12	WIDTH OF RADIUS-ULNA, DISTAL EXTREMITY.
13	ANTERIOR-POSTERIOR WIDTH, DISTAL EXTREMITY OF RADIUS-ULNA.

YYYY

**c**

DATA	MIXED DECK: ADULT AND JUVENILE RADIUS-ULNAE, MILBURN	(9)
3052-65A	L 66 459.00 429.00 344.00 80.00 131.00 97.00 91.00 52.00 55.00	
3052-65B	L 66 32.00 90.00 66.00 0.00 0.00 0.00 0.00 0.00 0.00	
3053-65A	L 66 411.00 393.00 316.00 65.00 100.00 86.00 83.00 46.00 47.00	
3053-65B	L 66 21.00 81.00 67.00 0.00 0.00 0.00 0.00 0.00 0.00	
3054-65A	L 66 416.00 399.00 321.00 66.00 106.00 83.00 80.00 45.00 41.00	
3054-65B	L 66 21.00 75.00 57.00 0.00 0.00 0.00 0.00 0.00 0.00	
3056-65A	L 66 0.00 0.00 315.00 0.00 0.00 85.00 83.00 47.00 43.00	
3056-65B	L 66 0.00 75.00 55.00 0.00 0.00 0.00 0.00 0.00 0.00	
3058-65A	L 66 408.00 398.00 320.00 68.00 109.00 89.00 86.00 46.00 46.00	
3058-65B	L 66 23.00 81.00 56.00 0.00 0.00 0.00 0.00 0.00 0.00	
3060-65A	L 66 430.00 419.00 319.00 74.00 132.00 99.00 92.00 50.00 50.00	
3060-65B	L 66 30.00 86.00 69.00 0.00 0.00 0.00 0.00 0.00 0.00	
3064-65A	L 66 478.00 458.00 364.00 81.00 141.00 127.00 120.00 50.00 50.00	(10) ↗
3064-65B	L 66 29.00 91.00 71.00 0.00 0.00 0.00 0.00 0.00 0.00	
3071-65A	L 66 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	
3071-65B	L 66 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	

SECVAR

**d**

IN	MEAS	N	MIN	(MEAN)	MAX	RANGE	MEDIAN	S DEV	CVAR	SEMEAN	SEMEDN	SESEDEV	SECVA
66	1	31	380.00	(422.61)	493.00	113.00	413.00	29.76	7.04	5.35	6.68	3.78	0.8
66	2	31	370.00	(405.58)	470.00	100.00	399.00	26.80	6.61	4.81	6.02	3.40	0.8
66	3	40	296.00	(323.77)	375.00	79.00	320.00	17.97	5.55	2.84	3.55	2.01	0.6
66	4	33	56.00	(64.03)	82.00	26.00	66.00	6.91	10.02	1.20	1.50	0.85	1.2
66	5	34	91.00	(112.15)	147.00	56.00	107.00	15.70	14.00	2.69	3.37	1.90	1.7
66	6	39	78.00	(88.62)	112.00	34.00	66.00	8.70	9.81	1.39	1.74	0.98	1.1
66	7	39	75.00	(84.05)	101.00	26.00	82.00	7.19	8.55	1.15	1.44	0.81	0.9
66	8	39	42.00	(46.85)	60.00	18.00	46.00	4.25	9.08	0.68	0.85	0.48	1.0
66	9	40	39.00	(46.05)	61.00	22.00	44.00	6.07	13.17	0.96	1.20	0.68	1.0
66	10	43	24.00	(29.40)	41.00	17.00	28.00	3.81	12.97	0.60	0.75	0.43	1.0
66	11	33	19.00	(24.00)	34.00	15.00	22.00	4.18	17.41	0.73	0.91	0.51	2.0
66	12	40	65.00	(79.30)	99.00	34.00	76.00	8.08	10.23	1.28	1.60	0.90	1.0
66	13	39	52.00	(65.00)	88.00	36.00	62.00	9.19	14.14	1.47	1.84	1.04	1.0
66	14	0	0.00	(0.00)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
66	15	0	0.00	(0.00)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
66	16	0	0.00	(0.00)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
66	17	0	0.00	(0.00)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
66	18	0	0.00	(0.00)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
66	19	0	0.00	(0.00)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
66	38	0	0.00	(0.00)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
66	39	0	0.00	(0.00)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
66	40	0	0.00	(0.00)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

THE NUMBER OF SPECIMENS IS 43

Table 1. The mammalian bone-code, listing the elements of the mammalian skeleton with identifying code-numbers assigned to each element. The number is placed in cc 18-20 on each data card. Note the aberrant 900-numbers for unidentified teeth; these illustrate a technique for revision of the code, presented here as a "third approximation."

C	CRANIAL ELEMENTS			
C	1 SKULL FRAGMENT	8 UC-1	16 LI-1	24 LP-3
C	2 MANDIBLE RAMUS	9 UP-1	17 LI-2	25 LP-4
C	TEETH	10 UP-2	18 LI-3	925 UNIDENT. LPM
C	3 UI-1	11 UP-3	19 LI-4	26 LM-1
C	4 UI-2	12 UP-4	20 LI-5	28 LM-2
C	5 UI-3	912 UNIDENT. UP-	920 UNIDENT. LI-	28 LM-3
C	6 UI-4	13 UM-1	21 LC-1	928 UNIDENT. LM-
C	7 UI-5	14 UM-2	22 LP-1	29 UNIDENT. TOOTH
C	907 UNIDENT. UI-	15 UM-3	23 LP-2	30 GREAT CORNU HYOID
C		915 UNIDENT. UM-		31 MINOR CORNU HYOID
C	AXIAL ELEMENTS			
C	32 CV-1 ATLAS	40 TV-1	48 TV- 9	56 LV-3
C	33 CV-2 AXIS	41 TV-2	49 TV-10	57 LV-4
C	34 CV-3	42 TV-3	50 TV-11	58 LV-5
C	35 CV-4	43 TV-4	51 TV-12	59 LV-6
C	36 CV-5	44 TV-5	52 TV-13	60 UNIDENT LV
C	37 CV-6	45 TV-6	53 UNIDENT TV	61 SACRUM
C	38 CV-7	46 TV-7	54 LV- 1	62 CAUDAL V. UNDIFF.
C	39 UNIDENT CV	47 TV-8	55 LV- 2	63 -----
C	FORE-LIMB ELEMENTS			
C	64 SCAPULA	70 ULNAR C.	76 MC-2	
C	65 HUMERUS	71 ACCESSORY C.	77 MC-3 (CANNON)	
C	66 RADIUS(-ULNA)	72 C(2+3) C.	78 MC-4	
C	67 ULNA	73 C-4 C.	79 MC-5	
C	68 RADIAL C.	74 CARPAL UNDIFF.	80 UNIDENT MC	(SPLINT)
C	69 INTERMEDIATE C.	75 METACARPAL-1	81 -----	
C	PHALANGES ( PHALANX ONE, DIGIT TWO)			
C	PHALANGES ( PHALANX ONE, DIGIT TWO)			
C	82 P-I-D-1	87 P-II-D-1	92 P-III-D-1	97 UNIDENT PHALANX
C	83 P-I-D-2	88 P-II-D-2	93 P-III-C-2	
C	84 P-I-D-3	89 P-II-D-3	94 P-III-D-3	NOTE. FOR ARTIODAC-
C	85 P-I-D-4	90 P-II-D-4	95 P-III-C-4	TYLS, -RIGHT- PHAL-
C	86 P-I-D-5	91 P-II-D-5	96 P-III-C-5	ANGES ARE DIGIT -3-
C				AND -LEFT- PHALANGES
C				ARE DIGIT -4-.
C	HIND-LIMB ELEMENTS			
C	97 PELVIS	103 LAT.MAL.FIB.	109 MT-2	
C	98 FEMUR	104 T-(1)	110 MT-3 (CANNON)	
C	99 TIBIA	105 T-(2+3)	111 MT-4	
C	100 FIBULA	106 T-(C+4)	112 MT-5	
C	101 CALCANEUM	107 UNIDENT TARS.	113 UNIDENT MT	(INCLUDES SPLINT).
C	102 ASTRAGALUS	108 MT-1	114 -----	
C	RIB-CAGE ELEMENTS			
C	115 R- 1	119 R- 5	123 R- 9	127 R-13
C	116 R- 2	120 R- 6	124 R-10	128 UNIDENT. RIB
C	117 R- 3	121 R- 7	125 R-11	129 COSTAL CART.
C	118 R- 4	122 R- 8	126 R-12	130 -----
C	ACCESSORY ELEMENTS			
C	131 CLAVICLE	134 XIPHISTERNUM	137 SESAMOID DIST	140 -----
C	132 STERNEBRA	135 PATELLA	138 BACULUM	141 -----
C	133 MANUBRIUM	136 SESAMOID PROX	139 OS CLITORIS	142 -----

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Table 2. PROGRAM BIostat, in facsimile.

2-1

## JCL Machine Control

```
//HILLERUD JOB MUSEAA304300,'BIostat40',MSGLEVEL=1,PRTY=7,CLASS=A JOB 415
//WATFIV EXEC WATFIV,REGION=GO=200K
XXWATFIV PKJC PKGS=WATFIV,PLOT=DUMMY 00001000
*** IF YOU WISH TO PLOT SPECIFY PLOT='VOL=PRIVATE' ON THE EXEC CARD 00002000
*** AND PROG=WATPLOT 00003000
XGGO EXEC PGM=6PRGG,REGION=140K 00004000
IEF6531 SUBSTITUTION JCL - PGM=WATFIV,REGION=140K
//SYSPRINT DD SYSOUT=(G,,0200)
X/SYSPRINT DD SYSOUT=A 00005000
XXWATLIB DD DSN=SYS1.WATLIB,UNIT=2314,VOL=SER=SYSKS1,DISP=SHR, 00006000
XX DCB=(LRECL=10,BLKSIZE=160,RECFM=FB) 00007000
XXFT01F001 DD DUMMY 00008000
XXFT02F001 DD DUMMY 00009000
XXFT03F001 DD DUMMY 00010000
XXFT04F001 DD DUMMY 00011000
XXFT05F001 DD DDNAME=SYSIN 00012000
//GO.FT06F001 DD SYSOUT=(G,,0200),DCB=(RECFM=FB,LRECL=133,
// BLKSIZE=133)
X/FT06F001 DD SYSOUT=A,DCB=(RECFM=FB,LRECL=133,BLKSIZE=133) 00013000
XXFT07F001 DD SYSOUT=B 00014000
XXPLOTTAPE DD &PLOT,UNIT=TAPE,DISP=NEW,LABEL=(,NL) 00015000
IEF6531 SUBSTITUTION JCL - DUMMY,UNIT=TAPE,DISP=NEW,LABEL=(,NL)
//GO.SYSIN DD *
//
IEF1421 - STEP WAS EXECUTED - COND CODE 0000
IEF3731 STEP /GO / START 72252.1452
IEF3741 STEP /GO / STOP 72252.1453 CPU 0MIN 06.79SEC MAIN 200K LCS OK
extended line ↘
```

STEP	/RGH/RGL/CPU	TIME/DP/	DISK/	TAPE/	2250/	1403/	CELL/	2540R/	2540P/
GO	200	0	6.79	7	12	0	0	0	0

```
continued ↘ SYSIN/H-PRINT/H-PUNCH/EFF-CUR-TM/ CHARGE
IEF3751 JOB /HILLERUD/ START 72252.1452 526 606 0 7.51 0.89
IEF3761 JOB /HILLERUD/ STOP 72252.1453 CPU 0MIN 06.79SEC
```

JOBNAME	ACCOUNT	PRTY	CLASS	TOTAL CHARGE	BALANCE
HILLERUD	MUSEAA304300	07	A	0.58	49.51

## Program

```

SJOB
C PROGRAM BIostat
C THIS PROGRAM DEVELOPES SIMPLE STATISTICS ON BIOMETRIC DATA. DATA-
C INPUT CARDS HAVE THE FOLLOWING FORMAT.
C CC-1 TO 8 -- MUSEUM IDENTIFICATION NUMBER
C C - 9 -- CARD IDENTIFICATION (A,B,C,D), WITH MEASUREMENTS 01-10
C ON THE A-CARD, M--11-20 ON THE B-CARD, M--21-30 ON THE
C C-CARD, AND M--31-40 ON THE D-CARD.
C C - 10 -- SEX (M,F, ): MALE, FEMALE, NOT DETERMINED.
C CC-11 TO 12 -- SITE: (RESERVED FOR STRATIGRAPHIC HORIZON).
C C - 13 -- POSITION (L,R, ): LEFT, RIGHT, NOT APPLICABLE.
C CC-15 TO 17 -- AGE-CODE (VARIOUS, EG., JUV): BLANK INDICATES MATURE.
C CC-18 TO 20 -- BONE-CODE (INTEGER). ELEMENT IDENTIFICATION. SEE
C LISTING WHICH FOLLOWS.
C CC-21 TO 80 -- MEASUREMENTS (10F6.2). MEASUREMENT RANGE 0.1 TO 9999.9
C MILLIMETERS.
C
1 INTEGER*4 CARD,SEX,SITE,PUSID,AGE,BONE
2 REAL*4 MEASUR
3 REAL*8 MUID,HMUID
4 COMMON MUID(201), MEASUR(201,10), RMIN(40), RMEAN(40), RMAX(40),
1 RANGE(40), RMEDN(40), STNDEV(40), RCVAR(40), SEMEAN(40),
2 SESDEV(40), SFCVAR(40), SEMEDN(40), CARD(201), SEX(201),
3 SITE(201), POSID(201), AGE(201), BONE(201), Z(51,40),
4 ICNTA, BONE, ILPP, IN, IO, IF, SUM(40), N10, N40, N50,
5 NS1, N55, N200, N201, I
5 IN=5
6 IN=6
7 IE=8
C TO TAILOR THIS PROGRAM TO A SPECIFIC MACHINE, CHANGE THE INPUT AND
C OUTPUT CODES IN THE LINES ABOVE TO CONFORM WITH THOSE USED BY THE
C NEW MACHINE. "IN" IS THE READ-IN CODE, "IO" IS THE READOUT CODE, IE
C IS A READOUT CODE WHICH CAN BE USED TO READ OUT DATA IN ERROR, BY
C ACTIVATING CERTAIN CONTROL CARDS MARKED "C***" IN CC 1-4.

```



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2-2

```

8      N10=10
9      • N40=40
10     • N50=50
11     N51=N50+1
12     N55=55
13     N200=200
14     N201=N200+1
15     DONE=0.0
16     1 CALL GTPREL
17     IF(DONE.EQ.2.0)GO TO 5
18     CALL GETDAT
19     CALL VERIFY
20     CALL PROCFS
21     CALL PUTDAT
22     IF(DONE.EQ.0.0)GO TO 1
23     WRITE(10,4)
24     4 FORMAT('1')
25     5 STOP
26     END

27     SUBROUTINE GTPREL
28     DIMENSION LINE(20)
29     INTEGER*4 DATAW
30     DATA DATAW,WYEE4/'DATA','YYYY'/
31     INTEGER*4 CARD,SEX,SITE,POSID,AGE,BONE
32     REAL*4 MEASUR
33     REAL*8 MUID,HMUID

34     COMMON MUID(201), MEASUR(201,10), RMIN(40), RMEAN(40), RMAX(40),
1      RRANGE(40), RMEDN(40), STNDEV(40), RCVAR(40), SEMEAN(40),
2      SESDEV(40), SECVAR(40), SEMEDN(40), CARD(201), SEX(201),
• 3      SITE(201), POSID(201), AGE(201), BONE(201), Z(51,40),
4      ICNTA, DONE, ILPP, IN, IO, IE, SUM(40), N10, N40, N50,
5      N51, N55, N200, N201, I
35     1 LINECT=0
36     WRITE(10,2)
37     ILPP=0
38     2 FORMAT('1'////)
39     5 READ(11,10,END=30)LINE
40     10 FURMAT(20A4)
41     IF(LINE(1).EQ.DATAW) GO TO 50
42     WRITE(10,20)LINE
43     LINECT=LINECT+1
44     IF(LINECT.GT.N40)GO TO 1
45     20 FORMAT(1H,18X,20A4)
46     ILPP=ILPP+1
47     IF(ILPP.LE.N55)GO TO 5
48     WRITE(10,25)
49     25 FORMAT('1')
50     ILPP=0
51     GO TO 5
52     30 DONE=2.0
53     50 WRITE(10,60)LINE
54     60 FORMAT('1',///,18X,20A4)
55     RETURN
56     END

57     SUBROUTINE GETDAT
58     REAL*8 WYEE4,WYEE8
59     INTEGER*4 ACRD
60     DATA WYEE4,WYEE8,ACRD/'YYYY', 'YYYYYYYY','A'/
61     INTEGER*4 CARD,SEX,SITE,POSID,AGE,BONE
62     REAL*4 MEASUR
63     REAL*8 MUID,HMUID
64     COMMON MUID(201), MEASUR(201,10), RMIN(40), RMEAN(40), RMAX(40),
1      RRANGE(40), RMEDN(40), STNDEV(40), RCVAR(40), SEMEAN(40),
2      SESDEV(40), SECVAR(40), SEMEDN(40), CARD(201), SEX(201),
• 3      SITE(201), POSID(201), AGE(201), BONE(201), Z(51,40),
4      ICNTA, DONE, ILPP, IN, IO, IE, SUM(40), N10, N40, N50,
5      N51, N55, N200, N201, I
65     110 FORMAT('1'////////)
66     ICNTA=0
C      ICNTA = THE NUMBER OF SPECIMENS...
67     DO 2 IZ=1,N201
68     CARD(IZ)=0
69     SEX(IZ)=0
70     SITE(IZ)=0
71     POSID(IZ)=0
72     AGE(IZ)=0
73     BONE(IZ)=0
74     DO 1 IY =1,N10
75     1 MEASUR(IZ,IY)=0.0
76     2 CONTINUE

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77      DO 3 IZ=1,N51
78      DO 3 IX=1,N40
79      3 Z(IZ,IX)=0,J
      C      READ DATA CARDS (MAXIMUM OF 200 PER DATA SET)
      C      I IS THE NUMBER OF CARDS READ IN.
      I=0
80      5 I=I+1
81      READ(IN,10,FND=99)MUID(I),CARD(I),SEX(I),SITE(I),POSID(I),AGE(I),
82      IPONE(I),(MEASUR(I,J),J=1,N10)
83      10 FORMAT(AH,2A1,A2,A1,1X,2A3,10F6.2)
84      IF(MUID(I).EQ.WYEFE8)GO TO 99
85      IF(I.EQ.N201)GO TO 80
86      IF(MUID(I).EQ.WYEFE4)GO TO 100
87      WRITE(10,70)MUID(I),CARD(I),SEX(I),SITE(I),POSID(I),AGE(I),
      IPONE(I),(MEASUR(I,J),J=1,N10)
88      70 FORMAT(' ',1X,A8,2A1,A2,A1,1X,2A3,1X, 10(F6.2,1X) )
89      ILPP=ILPP+1
90      IF(ILPP.LE.N55)GO TO 75
91      ILPP=0
92      WRITE(10,73)
93      73 FORMAT ('*')
94      75 IF(CARD(I).EQ.ACPO)ICNTA=ICNTA+1
95      IF(ICNTA.GT.N50)GO TO 85
96      GO TO 5
97      80 IF(MUID(I).EQ.WYEFE8)GO TO 99
98      IF(MUID(I).EQ.WYEFE4)GO TO 100
      C      MORE THAN 50 A-CARDS OR MORE THAN 200 DATA-CARDS HAVE BEEN DETECTED
      C      WITHOUT AN END-OF-SAMPLE YYYY-CARD. PROCESSING OF THE FIRST 50 DATA-SET
      C      WILL CONTINUE.
99      85 CONTINUE
100     IP=I
101     WRITE(10,90)MUID(IP),CARD(IP),SEX(IP),SITE(IP),POSID(IP),
      IAGE(IP),BONE(IP),(MEASUR(IP,J),J=1,N10)
102     90 FORMAT(' TRUNCATED DATA',2X,A8,2A1,A2,A1,1X,2A3,10F6.2)
103     IF(I.GT.N200)I=N200
104     GO TO 5
105     99 DONE=1.0
106     100 I=I-1
107     RETURN
108     END
      C      THE FORMAT STATEMENT 110 CONTROLS MARGIN SPACING. IT IS REFERENCED
      C      LINE 1, SUBROUTINE GETDAT.
WARNING**  FORMAT STATEMENT 110 IS UNREFERENCED

109     SUBROUTINE VERIFY
      C      THIS SUBROUTINE CHECKS FOR SAMENESS IN THE SEVEN IDENTIFICATION
      C      FIELDS PER CARD GROUP- AN A,B,C,D IN COL 9, AN X,F IN COL 10,
      C      SITE NUMBER IN COL 11-12, AN L,R IN COL 13, A JUV IN COL 15-17,
      C      AND PUTS THE A,B,C,D MEASUREMENTS IN THE Z-ARRAY.
110     INTEGER*4 ABCD(4), HCARD, HSEX, HPOSID, HSITE, HAGE, HBONE
111     DATA ABCD/'A','B','C','D'/
112     INTEGER*4 CARD,SEX,SITE,POSID,AGE,BONE
113     REAL*8 MEASUR
114     REAL*8 MUID,HMUID
115     COMMON MUID(201), MEASUR(201,10), RMIN(40), RMEAN(40), PMAJ(40),
      1 RRANGH(40), RMEON(40), STNDEV(40), RCVAR(40), SEMEAN(40),
      2 SESDEV(40), SECVAR(40), SEMEDN(40), CARD(201), SEX(201),
      3 SITE(201), POSID(201), AGE(201), BONE(201), Z(51,40),
      4 ICNTA, DONE, ILPP, IN, IO, IE, SUM(40), N10, N40, N50,
      5 N51, N55, N200, N201, I
116     M=0
117     J=0
118     L=0
119     4 J=J+1
120     IF(J.GT.1)GO TO 250
121     5 IF(CARD(J).NE.ABCD(1))GO TO 200
122     I1=0
123     I3=1
124     HMUID=MUID(J)
125     HCARD=CARD(J)
      C*** HSEX=SEX(J)
      C*** HSITE=SITE(J)
      C*** HPOSID=POSID(J)
      C*** HAGE=AGE(J)
      C      TO ACTIVATE VERIFICATION OF SAMENESS IN THE IDENTIFICATION FIELDS SITE,
      C      SEX, POSID, AGE ABOVE, DUPLICATE THE CARDS WITH ASTERISKS AS VALID
      C      STATEMENT CARDS, NOT COMMENT CARDS.
      C      AS WRITTEN, THE SUBROUTINE ALLOWS GROUPED-SAMPLE STATISTICS TO BE
      C      COMPUTED.
126     HBONE=BONE(J)
127     GO TO 30

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128      20 J=J+1
129      IF (J.GT.1) GO TO 250
130      IF (CARD(J).NE.ABCD(13)) GO TO 5
131      IF (MUID(J).NE.HMUID) GO TO 200
      C***
      C*** IF (SEX(J).NE.MSEX) GO TO 200
      C*** IF (SITE(J).NE.HSITE) GO TO 200
      C*** IF (POSID(J).NE.HPOSID) GO TO 200
      C*** IF (AGE(J).NE.HAGE) GO TO 200
      C      SET PREVIOUS COMMENT STATEMENT.
      C      IF (BONE(J).NE.HBONE) GO TO 200
132      30 (N) 50 L=1,N10
133      11=11+1
134      IF (MEASUR(J,L).EQ.0.0) GO TO 50
135      Z(N51,11)=Z(N51,11)+1
136      Z=Z(N51,11)
137      Z(12,11)=MEASUR(J,L)
138      50 CONTINUE
139      13=13+1
140      IF (11.GE.N40) GO TO 4
141      GO TO 20
142      200 CONTINUE
143      C      THE VERIFY SUBROUTINE HAS ENCOUNTERED EFRONEOUS DATA.
      C      WRITE ERROR CARD(S) AND GET NEXT A-CARD.
144      WRITE (10,20) MUID(J), CARD(J), SEX(J), SITE(J), POSID(J), AGE(J),
      BONE(J), (MEASUR(J,K), K=1, N10)
145      220 FORMAT(' DATA IN ERROR', 2X, A8, 2A1, A2, A1, 2A3, 10F6.2)
146      J=J+1
147      IF (J.LE.1) GO TO 5
148      250 RETURN
149      END

150      SUBROUTINE PROCES
151      INTEGER*4 CARD, SEX, SITE, POSID, AGE, BONE
152      REAL*4 MEASUR
153      REAL*8 MUID, HMUID
154      COMMON MUID(201), MEASUR(201,10), RMIN(40), RMEAN(40), RMAX(40),
      PRANGE(40), RMEDN(40), STNDEV(40), RCVAR(40), SEMEAN(40),
      SESIDEV(40), SECVAR(40), SEMEDN(40), CARD(201), SEX(201),
      SITE(201), POSID(201), AGF(201), BONE(201), Z(51,40),
      ICNTA, DONE, ILPP, IN, IO, IE, SUM(40), N10, N40, N50,
      N51, N55, N200, N201, I
      C      CALCULATE MIN, MAX, MEAN, AND MEDIAN, RANGE, MEASUR, I, Z
      C*** WRITE (IE,2)
      C***2 FORMAT('1 THE Z ARRAY')
      C*** DO 3 IO=1, N51
      C***3 WRITE (IE,5) (Z(IO,IG), IG=1, N40)
      C***5 FORMAT(' ', 4(10(F6.2, 4X)/5X))
      C      DUPLICATION OF CARDS WITH ASTERISKS AS VALID STATEMENT CARDS, NOT
      C      COMMENT CARDS, WILL WRITE THE Z-ARRAY (ALL DATA IN THE FIELD OF
      C      40 MEASUREMENTS ON EACH OF 50 SPECIMENS). THIS LOOP WAS USEFUL IN
      C      CHECKING TEST-DATA DURING INITIAL PRODUCTION OF PROGRAM BIOSTAT.
      C*** WRITE (IF,6) J
      C***6 FORMAT(' ', 5H J = ,14)
155      11=1
156      DO 50 J=1, N40
157      RMIN(J)=0.0
158      RMAX(J)=0.0
159      SUM(J)=0.0
160      RMEAN(J)=0.0
161      RMEDN(J)=0.0
162      PRANGE(J)=0.0
163      STNDEV(J)=0.0
164      RCVAR(J)=0.0
165      SEMEAN(J)=0.0
166      SESIDEV(J)=0.0
167      SECVAR(J)=0.0
168      SEMEDN(J)=0.0
169      ITIMES=Z(N51,J)
      C*** WRITE (IE,7) ITIMES
      C***7 FORMAT(' ', 9H ITIMES ,14)
170      IF (ITIMES.EQ.0) GO TO 50
171      IF (ITIMES.GT.N50) GO TO 50
172      IHALF=(ITIMES+21)/2
173      RMIN(J)=999.99
174      RMAX(J)=0.0
175      SUM(J)=0.0
176      RMEAN(J)=0.0
177      DO 9 I=1, ITIMES
178      IF (Z(I,J).LT.RMIN(J)) RMIN(J)=Z(I,J)
179      IF (Z(I,J).GT.RMAX(J)) RMAX(J)=Z(I,J)
180      SUM(J)=SUM(J)+Z(I,J)
181      9 CONTINUE

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182      DO 10 I=1, IHALF
183      DO 10 K=1, I*TIMES
184      IF (Z(I,J).GE.Z(K,J)) GO TO 10
185      RHL0=Z(I,J)
186      Z(I,J)=Z(K,J)
187      Z(K,J)=RHL0
188
189      10 CONTINUE
190      RMEAN(J)=SUM(J)/I*TIMES
191      RMEDN(J)=Z(IHALF,J)
192      RRANGE(J)=RMAX(J)-RMIN(J)
193
194      C*** WRITE(IE,15) RMEAN(J), RMEDN(J), RRANGE(J), SUM(J), RMAX(J), RMIN(J)
195      C**15 FORMAT(' ', 28H MEAN MEDN RANGE SUM MAX MIN, 6(F8.2, 5X))
196      C      COMPUTE THE STANDARD DEVIATION
197      RSUM=0
198      DO 20 K=1, I*TIMES
199      20 RSUM=RSUM+(RMEAN(J)-Z(K,J))**2
200      STNDEV(J)=SQRT(RSUM/I*TIMES)
201      C      COMPUTE THE COEFFICIENT OF VARIATION
202      RCVAR(J)=STNDEV(J)*100/RMEAN(J)
203      C*** WRITE(IE,17) STNDEV(J), RCVAR(J)
204      C**17 FORMAT(' ', 6HSTNDEV, 2X, F8.2, 2X, 6HRCVAR, 1X, F8.2)
205      C      COMPUTE THE STANDARD ERRORS OF MEAN, STANDARD DEVIATION,
206      C      COEFFICIENT OF VARIATION AND MEDIAN
207      RTIMES=I*TIMES
208      SEMEAN(J)=STNDEV(J)/SQRT(RTIMES)
209      SESDEV(J)=STNDEV(J)/SQRT(RTIMES*2)
210      SECVAR(J)=RCVAR(J)/SQRT(RTIMES*2)
211      SEMEDN(J)=1.25*STNDEV(J)/SQRT(RTIMES)
212      C*** WRITE(IE,19) SEMEAN(J), SESDEV(J), SECVAR(J), SEMEDN(J)
213      C**19 FORMAT(' ', 6HSEMEAN, 2X, F8.2, 2X, 6HSESDEV, 2X, F8.2, 2X,
214      C*** 1 6HSECVAR, 2X, F8.2, 2X, 6HSEMEDN, 2X, F8.2 )
215      50 CONTINUE
216      I=I+1
217      RETURN
218      END
219      C
220
221      SUBROUTINE PUTDAT
222      INTEGER*4 CARD, SEX, SITE, POSID, AGE, BONE
223      REAL*4 MEASUR
224      REAL*8 MUID, HMUID
225      COMMON MUID(201), MEASUR(201,10), RMIN(40), RMEAN(40), RMAX(40),
226      1 RRANGE(40), RMEDN(40), STNDEV(40), RCVAR(40), SEMEAN(40),
227      2 SESDEV(40), SECVAR(40), SEMEDN(40), CARD(201), SEX(201),
228      3 SITE(201), POSID(201), AGE(201), BONE(201), Z(51,40),
229      4 ICNTA, NONE, ILPP, IN, IO, IE, SUM(40), N10, N40, N50,
230      5 N51, N55, N200, N201, I
231      C      WRITE TITLES FOR STATISTICAL OUTPUT
232      WRITE(IO,5)
233      5 FORMAT('1'////)
234      WRITE(IO,10)
235      10 FORMAT('1', 15X, 2HID, 1X, 4HMEAS, 1X, 1HN, 2X, 3HMIN, 2X, 1H(, 6H MEAN, 1H),
236      12X, 3HMAX, 3X, 5HRRANGE, 1X, 6HMEDIAN, 3X, 5HSTNDEV, 2X, 4HRCVAR, 2X, 6HSEMEAN,
237      21X, 6HSEMEDN, 1X, 6HSESDEV, 1X, 6HSECVAR)
238      C      WRITE STATISTICAL VALUES
239      DO 20 J=1, N40
240      20 IZ=Z(N51,J)
241      WRITE(IO,15) BONE(1), J, IZ, RMIN(J), RMEAN(J),
242      1 RMAX(J), RRANGE(J), RMEDN(J), STNDEV(J),
243      2 RCVAR(J), SEMEAN(J), SEMEDN(J), SESDEV(J), SECVAR(J)
244      15 FORMAT(1H, 15X, A3, 1X, I2, 1X, I3, 1X,
245      1F6.2, 1H(, F6.2, 1H), F6.2, 1X,
246      28(F6.2, 1X))
247      20 CONTINUE
248      WRITE(IO,40) ICNTA
249      40 FORMAT(' ', 15X, 27H THE NUMBER OF SPECIMENS IS , I4)
250      RETURN
251      END

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\$ENTRY

End

YYYYYYYY

CORE USAGE OBJECT CODE= 17504 BYTES, ARRAY AREA= 24704 BYTES, TCTAL

-RFA AVAILABLE= 100448 BYTES

COMPILE TIME= 1.52 SEC, EXECUTION TIME= 4.82 SEC, WATFIV - VMS:IN 1

- LEVEL 2.5 - SEPTEMBER 1971

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